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UTILITY
PATENT APPLICATION
TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

First Inventor

Kaspar Tobias Winther

Title

Bonding of parts with dissimilar therm..

Express Mail Label No.

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Assistant Commissioner for Patents
Box Patent Application
Washington, DC 202311. ☒ Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)2. ☒ Applicant claims small entity status.
See 37 CFR 1.27.3. ☒ Specification [Total Pages 11]
(preferred arrangement set forth below)

- Descriptive title of the invention
- Cross Reference to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to sequence listing, a table, or a computer program listing appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

4. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 1]5. ☒ Oath or Declaration [Total Pages 2]

- a. ☒ Newly executed (original or copy)
- b. ☐ Copy from a prior application (37 CFR 1.63 (d))
(for continuation/divisional with Box 18 completed)
- i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s)
named in the prior application, see 37 CFR
1.63(d)(2) and 1.33(b).

6. ☐ Application Data Sheet. See 37 CFR 1.767. ☐ CD-ROM or CD-R in duplicate, large table or
Computer Program (Appendix)8. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)a. ☐ Computer Readable Form (CRF)

b. Specification Sequence Listing on:

i. ☐ CD-ROM or CD-R (2 copies); orii. ☐ paperc. ☐ Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. ☐ Assignment Papers (cover sheet & document(s))10. ☐ 37 CFR 3.73(b) Statement ☐ Power of
(when there is an assignee) Attorney11. ☐ English Translation Document (if applicable)12. ☐ Information Disclosure ☐ Copies of IDS
Statement (IDS)/PTO-1449 Citations13. ☐ Preliminary Amendment14. ☐ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)16. ☐ Nonpublication Request under 35 U.S.C. 122
(b)(2)(B)(i). Applicant must attach form PTO/SB/35
or its equivalent.17. ☒ Other: Amendment re. Provisional Patent..
Application18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment,
or in an Application Data Sheet under 37 CFR 1.76:☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)

of prior application No.: _____ / _____

Prior application information:

Examiner: _____

Group Art Unit: _____

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under
Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference.
The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

☐ Customer Number or Bar Code Label

(Insert Customer No. or Attach bar code label of form)

or



Correspondence address below

Name

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Kaspar Tobias Winther

Registration No. (Attorney/Agent)

Signature

K.T. Winther

Date

03/04/2002

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on
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FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT

(\$)

Complete if Known

Application Number

Filing Date

First Named Inventor

Kaspar Tobias Winther

Examiner Name

Group Art Unit

Attorney Docket No.

METHOD OF PAYMENT

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit
Account
Number

Deposit
Account
Name

☐ Charge Any Additional Fee Required
Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status.
See 37 CFR 1.27

2. ☐ Payment Enclosed:

☒ Check ☐ Credit card ☐ Money
Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Small Entity

Fee Fee Fee Fee
Code (\$) Code (\$) Fee Description

101	740	201	370	Utility filing fee
106	330	206	165	Design filing fee
107	510	207	255	Plant filing fee
108	740	208	370	Reissue filing fee
114	160	214	80	Provisional filing fee

Fee Paid

SUBTOTAL (1) (\$)

2. EXTRA CLAIM FEES

Total Claims	20	Extra Claims	20** = 0	Fee from below	9.00	Fee Paid	0.00
Independent Claims	3	- 3** =	0	x	42.00		0.00
Multiple Dependent							0.00

Large Entity Small Entity

Fee Fee Fee Fee
Code (\$) Code (\$) Fee Description

103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Fee Code	Large Entity (\$)	Fee Code	Small Entity (\$)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for <i>ex parte</i> reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,280	241	640	Petition to revive - unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify)

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)

SUBMITTED BY

Name (Print/Type)

Kaspar Tobias Winther

Registration No.
(Attorney/Agent)

Complete (if applicable)

Telephone

508-529-0093

Signature

K.T. Winther

Date

03/04/2002

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

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Rensselaer

OFFICE OF TECHNOLOGY
COMMERCIALIZATION

COPY

February 22, 2002

Tobias Winther
7 Walnut Street
Upton, MA 01568-1101

RE: Invention Disclosure "Materials for bonding parts with dissimilar thermal expansion coefficients",
RPI case no. 646, filed as provisional patent application 60/273,070 on March 5, 2001

Dear Tobias:

As discussed, after reviewing the referenced case in detail, Rensselaer has decided not to proceed with converting the provisional patent application. As a result of this decision, you requested in an email of February 21, 2002 that the rights to this invention be returned to you.

In response to your request, Rensselaer does hereby assign to you, as the sole inventor at Rensselaer, all of its rights, title and interest to the intellectual property rights pertaining to the invention described and/or claimed in the aforementioned disclosure.

Thank you for your help in this matter. Good luck in pursuing the technology.

Best regards,

Charles F. Rancourt
Director

cc. Harry Stephanou

Rensselaer Polytechnic Institute
110 8th Street | Troy, NY 12180-3590 USA | J-Building
Phone (518) 276-6023 | Fax (518) 276-6380 | www.rpi.edu/dept/otc

K. T. Winther
7 Walnut Street
Upton, MA 01568-1101
508-529-0093

March 4, 2002

U.S. patent and Trademark Office
Commissioner for Patents
Washington DC 20231

Amendment A

Cross reference to Related Application

The present patent "Bonding of Materials with Dissimilar Thermal Expansion Coefficients" is entitled to the benefit of Provisional patent Application number 60/273,070 filed on March 5, 2001. The original disclosure is attached.

Very respectfully,

K.T. Winther

Kaspar Tobias Winther

Title: Materials for bonding parts with dissimilar thermal expansion coefficients.

Inventor: Kaspar Tobias Winther, 400 Brunswick Drive, B10A12, Troy, NY 12180, citizen of Denmark.

Invention conceived: 2001 February 14.

First sketch of invention prepared: 2001 February 14.

First written description prepared: 2001 February 15.

People (other than inventor) who have knowledge of the invention:

Harry Stephanou

Beth Wales

Bob Reinick

Mark Pazder

Dan Popa

Problem addressed:

Permanent bonding between dissimilar materials is required in many products and components. In most cases the two materials will have different thermal expansion coefficients so when the temperature change fractures may form at or near the interface between the two materials. The fractures will naturally weaken the bond and eventually cause the parts to come apart. The temperature changes may reflect cooling from the processing temperature at which the parts were bonded to ambient or temperature cycles during the lifetime of the product / part.

Alternative solutions to the problem and their shortcomings:

There are basically two different approaches used today:

1. Use materials that match each other as closely as possible in terms of thermal expansion coefficients. Corning is for example offering a number of different specialty glasses that match a number of different materials in their thermal expansion coefficient. The problem with this approach is that these materials may otherwise have undesirable properties, e.g. maybe one component must be manufactured in silicon while another must be manufactured in metal, so Corning's glasses is of little help. Another issue is that the match in thermal expansion is often limited to a certain temperature range.
2. Use an intermediate layer that has sufficient compliance to take up the thermal mismatch. This layer could be an adhesive or either one or more layers of metals. The drawback of adhesives like epoxy is that they may decay over time and may not

withstand a number of environments. The drawback of the metal layers is that they themselves have different thermal expansion coefficients that ultimately can cause problems of their own.

Description of the invention:

Let us assume that we want to bond two materials, A and B, together with the thermal expansion coefficients α_A and α_B , respectively. The basic idea is to first form a sheet of glass or metal that gradually changes thermal expansion coefficient from α_A on one side to α_B on the other side and secondly bond the two materials, A and B, to this sheet. The fabrication of this sheet could be done in a number of ways; here are some examples:

- Two existing layers of "end-member" materials are polished, placed against each other and heated under pressure. The diffusion taking place will create a gradient in compositions and physical properties. Especially, for relative simple systems like two glasses with different Na to K ratios the changes in thermal expansion coefficients can be expected to be a monotonous (although not necessarily linear) function of composition. Similar sheets can be formed by alloying two different end member metals or alloys. After the diffusion, stress relief of the glass will most likely be required.
- Forming the glass or metal directly with a gradient, this could be done by simultaneous extrusion of different compositions, rolling of multiple layers or build up sheets of xerogel precursors with changing compositions followed by sintering. Subsequent heat treatment will further smoothen the gradients.

The bonding of the materials, A and B, to the sheet can take place with anodic bonding, diffusion bonding, adhesives or other methods. The thickness of the intermediary sheet will naturally have to depend on the difference in thermal expansion coefficients (between α_A and α_B), the elastic properties of the sheet and how uniform a gradient in thermal expansion coefficients can be achieved within the sheet.

Benefits over prior art:

The key benefit of this method is that the thermally induced strain is distributed across a layer of material rather than being concentrated at the interface. In this way the stress at any given point is reduced, and the material remains in the elastic region so cracks are avoided, thereby creating the basis for a long-term durable bond.

Problems that remain unresolved:

- The intermediate layer will, like Corning's specialty glasses, only match the thermal expansion coefficients of the neighboring materials over a certain temperature range. Of course if the two end-members are the two materials that need to be bonded together even this problem will go away.
- Additional thickness will be added to the structure being constructed.
- The compatibility of the intermediate layer will have to be verified.

None of these problems are, however, avoided in the currently used methods.

The following was received by the US Patent and Trademark Office:

Patent application filed by Kaspar Tobias Winther: "Bonding of parts with dissimilar thermal expansion coefficients" which consists of:

- Utility Patent Application Transmittal form (1 page)
- Fee Transmittal form for FY 2002 (1 page)
- Check #281 in the amount of three hundred seventy dollars
- Specification, claims and abstract (11 pages)
- Drawing (1 page)
- Declaration for Utility or Design Patent Application (2 pages)
- Amendment A regarding Provisional Patent (3 pages)
- Copy of letter from RPI (1 page)

11/11/01 11:11 AM